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(54) Title: MOIRÉ SECURITY DEVICE			
(57) Abstract			
<p>A security document or device having a first array of dots or lines having a predetermined number of lines per centimetre and a predetermined screen angle, a second array of dots or lines applied to or produced by a separate device and producing a grey scale visible effect, said second array being capable of being superimposed over the first array and having a different number of lines and screen angle calculated from the number lines and screen angle of the first array to produce a visible moiré pattern when the arrays are superimposed to establish the authenticity of the document or device.</p>			

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Moiré Security Device

Field of the Invention

This invention relates to security devices for use with banknotes, security documents and other devices requiring a security check.

5 Background of the Invention

The moiré effect is well known in the printing of half tone colour images, and the effect occurs when printing one half tone image over another. The printing industry seeks to minimise moiré effects to a level which is not visible to the naked eye.

In US Patent 3,675,948 (Wicker), there is disclosed a half tone printing method
10 in which a verifying image is hidden by half tone screens of different angles and revealed as a blinking image by a superimposed further screen. The process for forming the hidden image is complex, requiring the careful alignment and cutting of the film forming the half tone screen.

GB Patent 2191733 discloses a similar verifying system which requires an
15 image to be hidden in one half tone screen and revealed by a precisely identical half tone screen overlying the first. This arrangement again requires a complex production process involving the replacement of part of the first half tone screen with the required image, and can only be viewed as a reflected image.

US Patent 4,921,278 discloses a computer generated moiré identification system
20 in which a hidden image is revealed as a moiré pattern by the use of a computerised read-out device. This arrangement does not lend itself to printed applications and requires a computer to generate and read the verifying image.

In WO93/24333 De la Rue, a holographic security device is illustrated in which
25 a holographic moiré effect is produced by surface relief patterns on overlapping films. Surface relief patterns are not easily applied as part of a standard printing process and accordingly this device is likely to be difficult to implement in practice.

In EU 279526 a security document has parallel lines in which the thickness varies along their length to produce a moiré pattern in the document as produced. This arrangement does not lend itself to a verification process in which the moiré pattern is
30 advantageously only visible during verification.

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Summary of Invention and Object

It is an object to provide an improved security document or device enabling the generation of a moiré effect verifying image.

The invention provides a security document or device comprising a first array 5 of dots or lines applied to the surface of the document or device and producing a grey scale visible effect, a second array of dots or lines applied to or produced by a separate device and producing a grey scale visible effect, said second array being capable of being superimposed over the first array, each of said arrays being formed at a predetermined screen angle and screen value such that when the arrays are 10 superimposed, a visible moiré pattern is produced to establish the authenticity of the document or device.

The second array may be printed on a transparent sheet or may be computer generated during the verification process. The presence of the moiré pattern may be detected visually, optically or electronically.

15 The first array, and preferably the second array, are preferably reproduced by the Gravure printing process. The advantage of producing at least the first array by the Gravure process is that the first array can be conveniently incorporated into a printing process for the security document or device, such as a banknote.

20 The first array and second array may be printed on different parts of the document or device, which are adapted to be folded to superimpose the second array over the first array to produce the verifying moiré effect. Alternatively, for additional security, the second array may be printed on a separate sheet or separately stored in a computer for use during a verification process. In a simple form of the invention, the second array may be printed on a transparent sheet capable of being superimposed over 25 the first array to produce the required moiré verification image in transmission.

If desired, the first and/or second arrays can be printed in colour or incorporated into the Gravure printing process producing the document or device. For example, in a banknote, the first array can be incorporated into the printing on the banknote so that it is not readily detectable and will not be reproduced by known copying processes.

30 At least the first array is preferably printed as a thin layer of white or light coloured ink so that the printed features are translucent and therefore difficult to scan or photocopy. If the second array is not separate, it is preferably similarly printed.

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The invention also provides a method of producing a document or device as defined above, comprising the steps of selecting a first array of dots or lines having a predetermined number of lines per centimetre and a predetermined screen angle, calculating the number of lines per centimetre and screen angle of a second array of 5 dots or lines to produce a predetermined moiré pattern, mechanically engraving a Gravure printing cylinder to produce at least said first array, and printing said document or device using said engraved printing cylinder.

Brief Description of the Drawings

In the drawings:

10 Figure 1 illustrates two different mechanically engraved patterns, the first being 70 lines/cm, 60° screen angle, and the second 100 lines/cm, 45° screen angle, the arrows indicating the direction around the printing cylinder;

Figures 2 and 3 illustrate dot arrangements produced by Gravure screens of 59 lines/cm, 38° screen angle and 66.5205 lines/cm, 44.8032° screen angle, and

15 Figure 4 illustrates the superimposition of the screens of Figures 2 and 3 and the resultant moiré pattern.

Description of Preferred Embodiment

The Gravure process is a common, well known printing method. Gravure cylinders which transfer ink to the substrate to be printed are specific to the Gravure 20 process and traditionally are made by mechanical engraving or chemical etching. The chemical etching process produces dot arrays similar to many other printing processes (e.g. Flexographic printing, Offset Lithography).

Mechanical engraving involves revolving a cylinder under a reciprocating stylus, which at its lowest point gouges a deep cell and at its highest point remains clear 25 of the cylinder. In between these extremities of stylus position cells of varying depth and volume can be produced. This is illustrated in Figure 1 of the drawings.

Whilst the cylinder is rotated at a specific constant speed and the engraving head, holding the stylus, is driven axially along the surface of the cylinder at a specific constant speed, and the stylus is reciprocated at a specific, and constant, number of 30 cycles per second, there results an array of dots. This array is constrained by the requirement to produce an exact odd number of dots around twice the cylinder

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circumference, so that the array remains essentially mirror imaged. It is the useful properties arising from gravure screens produced under this constraint that form the preferred embodiment of this invention.

One useful pattern that can only be produced by the type of gravure arrays described above is that of parallel lines, either horizontal or vertical, at very specific distances apart as illustrated in Figure 1.

The two defining properties of a gravure array are the screen angle and the lines per centimetre. The lines per centimetre is a measure of the fineness of the screen. The screen angle provides information to avoid moiré in normal printing. Both properties can most usefully be related to the vertical and horizontal pitch of the dots in the gravure engraved array in the following manner.

$$\text{Horizontal dot pitch} = \frac{10000 * \sqrt{2}}{\text{Lines/cm} * \sqrt{\tan(\text{screenangle})}} \quad 1 \quad (1)$$

$$\text{Vertical dot pitch} = \frac{10000 * \sqrt{2} * \sqrt{\tan(\text{Screenangle})}}{\text{Lines/cm}} \quad 2 \quad (2)$$

Other useful relationships are:

$$\text{Screen angle} = \alpha \tan \frac{\text{Verticalpitch}}{\text{Horizontalpitch}} \quad 3 \quad (3)$$

$$\text{Lines/cm} = \frac{10000 * \sqrt{2} * \sqrt{\tan(\text{screenangle})}}{\text{Verticalpitch}} \quad 4 \quad (4)$$

To produce parallel lines we require that the number of cells within the distance between the lines, differ by exactly one in each of the two arrays. We can achieve this and concurrently keep the number of cells in the measurement collinear to the lines exactly equal, producing no pattern perpendicular to the lines.

This can be calculated as follows:

The first array can be designated as required, the second array can then be calculated to produce the desired moiré with the first.

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From the screen angle and lines/cm of the first array, the horizontal and vertical pitches of the dots can be calculated using the formulas (1) and (2) above.

If we wish to produce a vertical moiré pattern of parallel lines x centimetres apart, then the vertical pitch is kept the same as for the first array. The new horizontal
5 pitch is calculated thus:

$$\text{New horizontal pitch} = \frac{\frac{x * 1000}{x * 1000}}{\frac{\text{oldhorizontalpitch}}{5}} + 1 \quad (5)$$

Now the new array screen angle and lines/cm can be calculated by applying formulas (3) and (4).

If a horizontal moiré is required then horizontal pitch is kept constant and the
10 vertical pitch is changed as per equation (5) but using old vertical pitch.

Of course many other moiré patterns can be produced and maybe useful in security devices. For example, by simply changing the screen angle between the two arrays by a small amount (for example: 4 degrees) a visible criss cross pattern will appear.

15 The following example demonstrates the effect at a magnification of 30 times.

Figure 2 shows the dot arrangement for a gravure screen of 59 lines/cm and a screen angle of 38 degrees.

By utilising formulas 1, 5, 3 and 4 it can be calculated that to produce a vertical moire pattern of 1mm pitch a 66.5205 lines/cm screen at a screen angle of 44.8032
20 degrees is required. The dot arrangement of this screen is shown in Figure 3.

Figure 4 shows the superimposition of these two screens and the resultant moire pattern of vertical lines with a pitch of 1mm.

Part of the security in the invention is in the accuracy required of reproducing the dot arrays. Any small inaccuracy will lead to noticeably large changes in the moiré
25 pattern.

The design of moiré patterns can result in aesthetically impacting designs with dramatic optical variability. By utilising the above described predictive method and the gravure cylinder making technique also described above, a design can be incorporated

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onto any position of the gravure cylinder that when printed will appear identical to some other area. However, when superimposed with a complementing array produced from a second gravure cylinder, the verifying image will be revealed in transmission.

Claims:

1. A security document or device comprising a first array of dots or lines applied to the surface of the document or device and producing a grey scale visible effect, a second array of dots or lines applied to or produced by a separate device and producing
5 a grey scale visible effect, said second array being capable of being superimposed over the first array, each of said arrays being formed at a predetermined screen angle and screen value such that when the arrays are superimposed, a visible moiré pattern is produced to establish the authenticity of the document or device.
2. The document or device of claim 1, wherein the second array is printed on a
10 substantially transparent sheet or portion of a sheet.
3. The document or device of claim 1, wherein the second array is computer generated during a verification process.
4. The document or device of claim 1 or 2, wherein the first array and/or the second array are reproduced by a Gravure printing process.
- 15 5. The document or device of claim 1 or 2, wherein at least the first array is reproduced by a Gravure printing process.
6. The document or device of claim 4 or 5, wherein the first and/or second array is/are printed during the printing of the document by a Gravure process.
- 20 7. The document or device of any preceding claim, wherein the first and second arrays are printed on different parts of the document, which is adapted to be folded to superimpose the second array over the first array, or vice versa, to produce the verifying moiré effect.
8. The document or device of any preceding claim, wherein the first and/or second arrays are printed in colour or incorporated into the printing on the document so that the
25 array(s) are not readily detectable and are not reproduced by known copying processes.
9. A method of producing a document or device according to any preceding claim, comprising the steps of selecting a first array of dots or lines having a predetermined number of lines per centimetre and a predetermined screen angle, calculating the number of lines per centimetre and screen angle of a second array of dots or lines to
30 produce a predetermined moiré pattern, mechanically engraving a Gravure printing

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cylinder to produce at least said first array, and printing said document or device using said engraved printing cylinder.

10. The method of claim 9, wherein said printing cylinder, or another Gravure printing cylinder is similarly engraved to produce said second array of dots or lines.

5 11. The method of claim 9 or 10, wherein said calculation is performed using the formulae (1) to (5) as described herein.

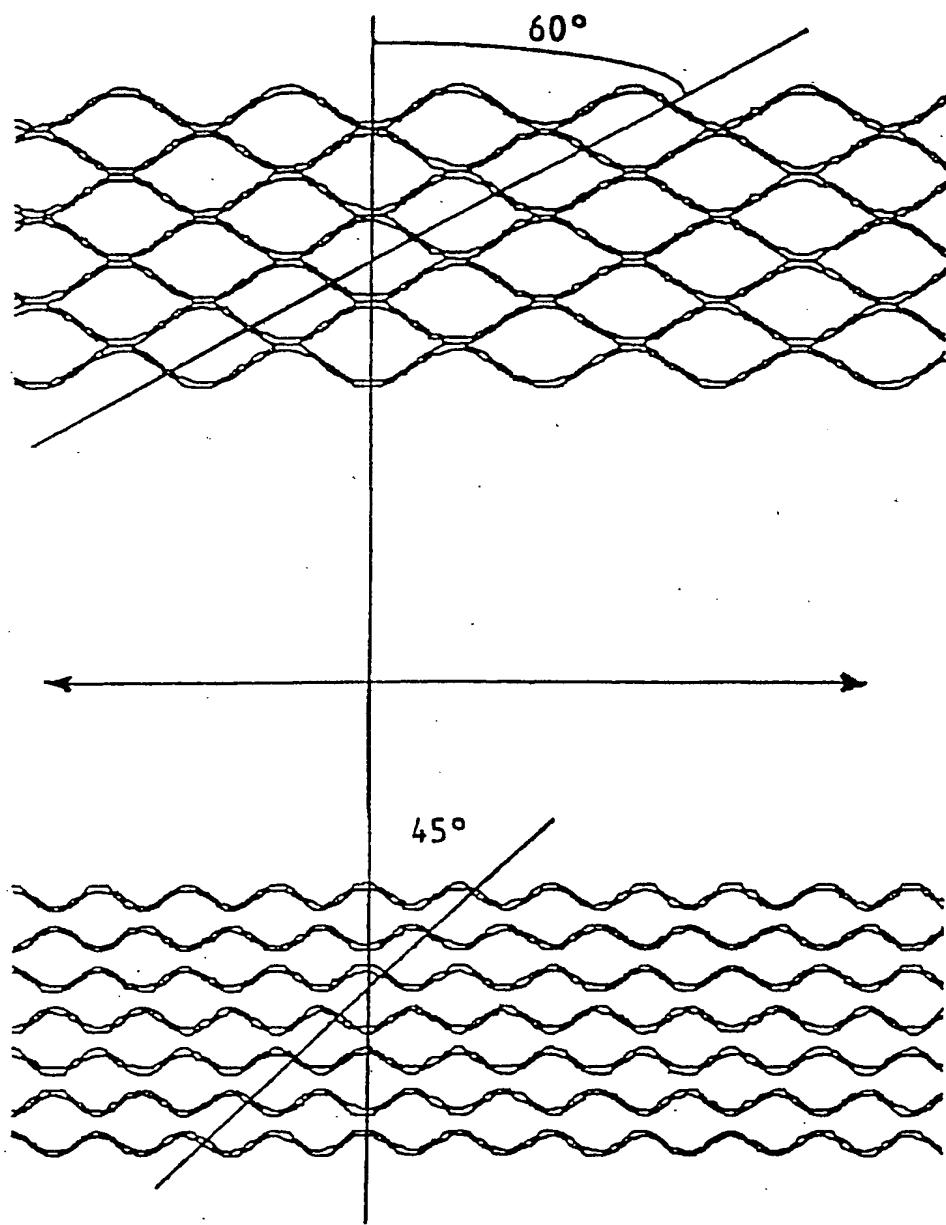
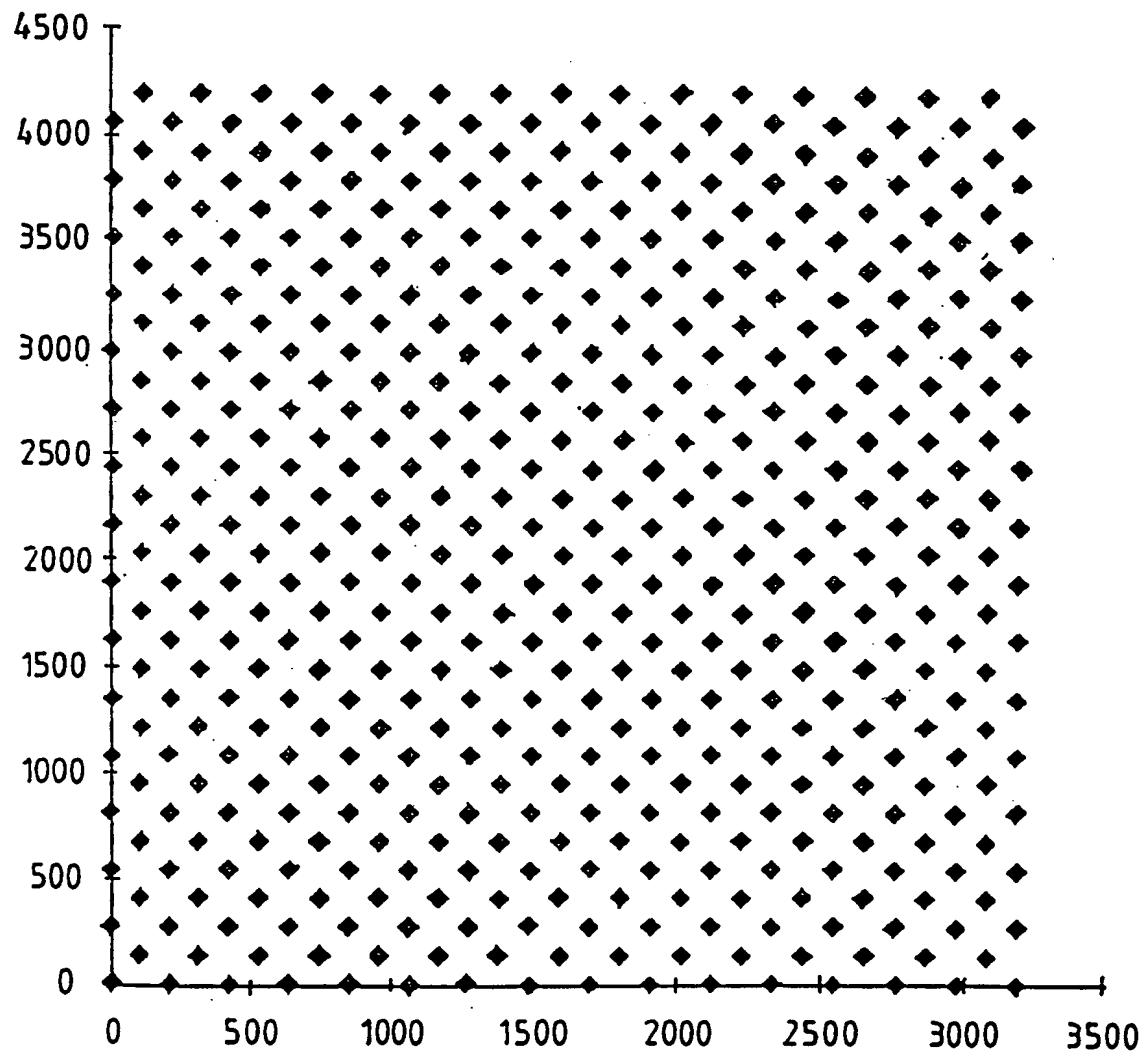


FIG. 1 -



III. 2.

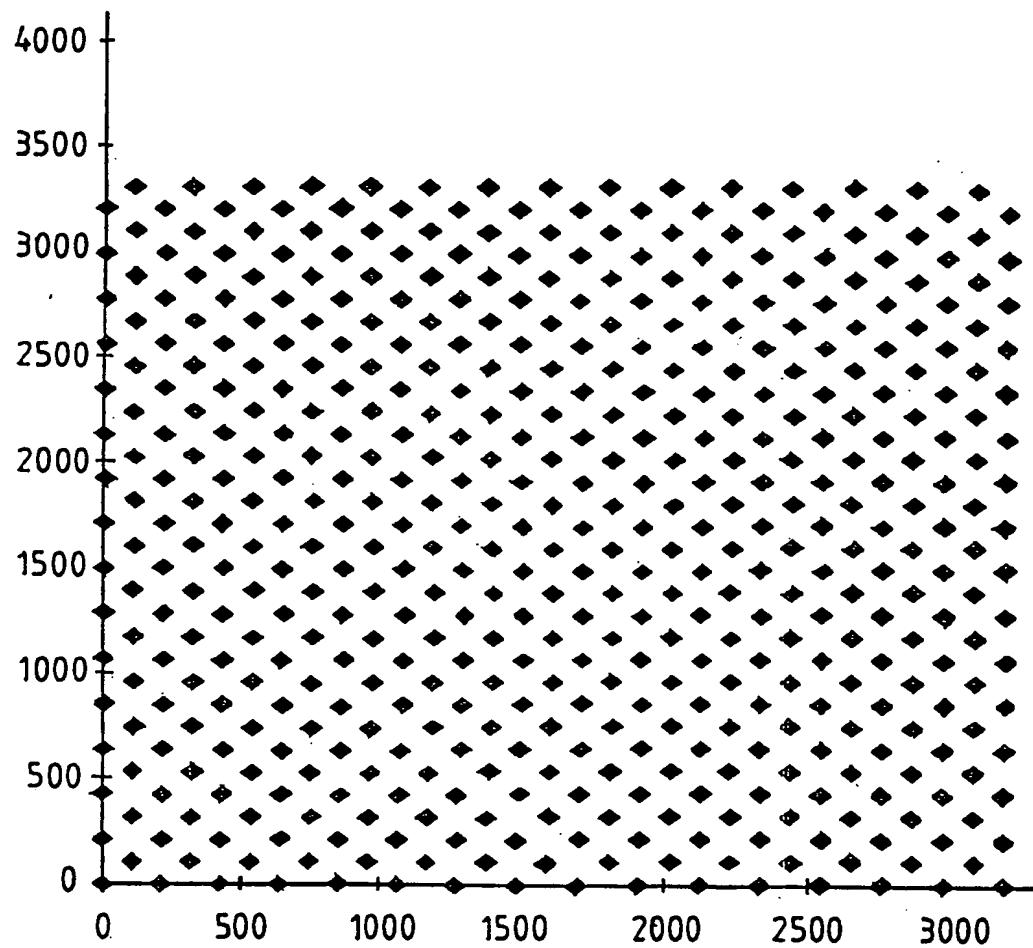
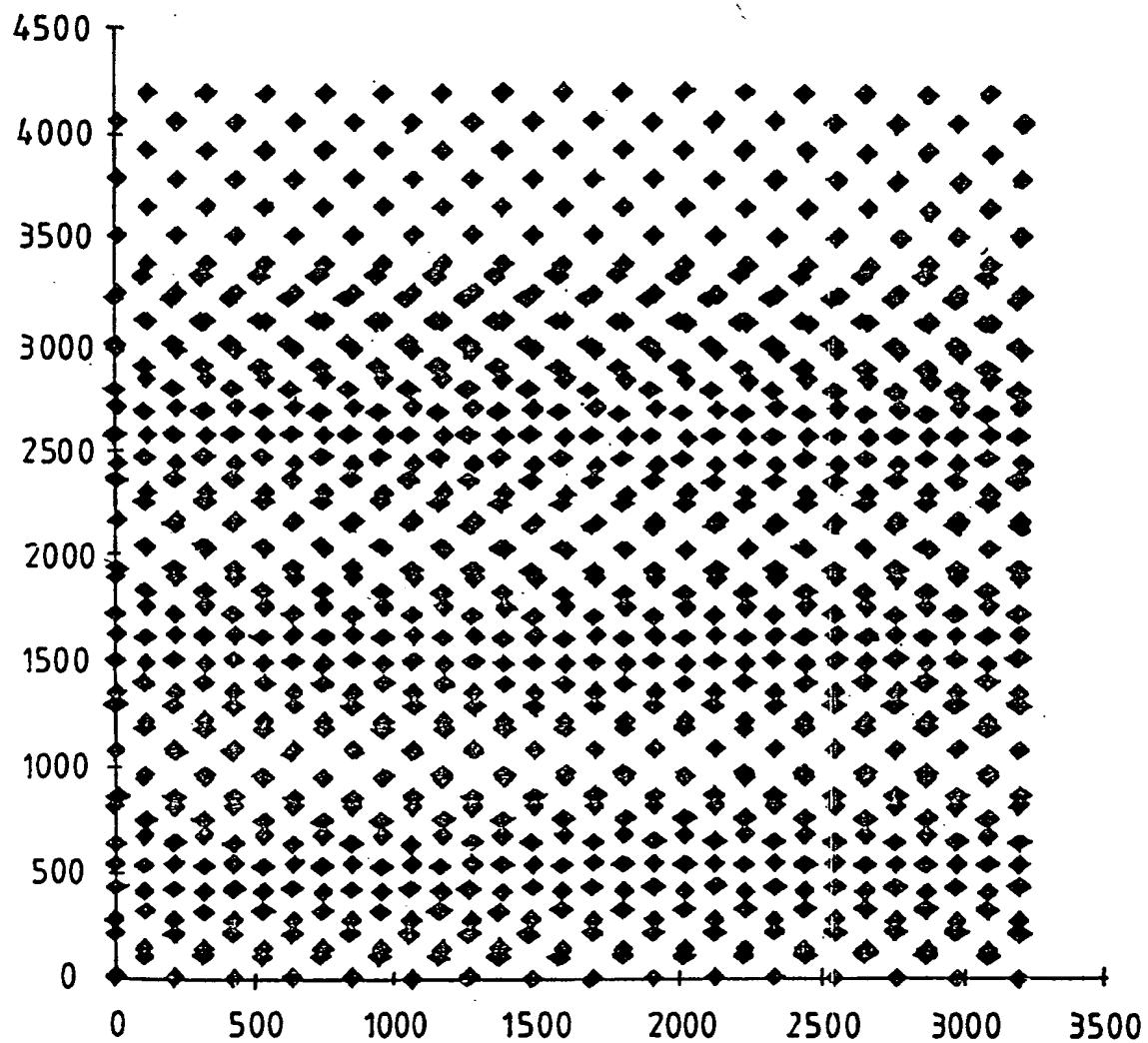


FIG. 3



III. 2.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 98/00963

A. CLASSIFICATION OF SUBJECT MATTER		
Int Cl ⁶ : B42D 15/10; B41M 3/14; B44F 1/12		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B42D 15/10; B41M 3/14; B44F 1/08, 1/10, 1/12		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched IPC : as above		
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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 93/24333 A1 (DE LA RUE HOLOGRAPHICS LTD) 9 December 1993 whole document	1-11
X	EP 279526 A2 (METAL BOX PLC) 24 August 1988 abstract, page 2 line 8 - page 3 line 51 figure	1-11
Y	DE 3208204 A1 (FRAUNHOFER-GES FORDANGE) 15 September 1993 whole document	1-11
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INTERNATIONAL SEARCH REPORT
Information on patent family members

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Patent Document Cited in Search Report			Patent Family Member			
WO	93/24333	EP	632767	US	5694229	
EP	279526	CA	1322015	EP	279526	GB 2204272
		US	4884828			

END OF ANNEX